A U.S. Department of Energy National Laboratory

News Release

Contact: Brock Cooper
(630) 252-5565
bcooper@anl.gov
For immediate release

Argonne researchers win four R&D 100 awards

ARGONNE, Ill. (July 20, 2009) — Researchers from the U.S. Department of Energy's (DOE) Argonne National Laboratory received four R&D 100 awards as judged by R&D Magazine.

“The Department of Energy's national laboratories are incubators of innovation, and I'm proud they are being recognized once again for their remarkable work,” said Energy Secretary Steven Chu. “The cutting-edge research and development being done in our national labs is vital to maintaining America’s competitive edge, increasing our nation’s energy security, and protecting our environment. I want to thank this year's winners for their work and congratulate them on this award.”

The awards recognize the top scientific and technological innovations of the past year. Argonne scientists have won 105 R&D 100 awards since they were first introduced in 1964.

"These awards are a testament to the hard work and ingenuity that have become a hallmark here at Argonne," Laboratory Director Eric Isaacs said. "The research that occurs at Argonne will help solve the great challenges facing our planet and usher in a better tomorrow."

This year’s winners from Argonne are:

- High Performance Software for Engineering and Science
- Super hard and slick coating for increased engine efficiency and component reliability
- The Hard X-ray Nanoprobe
- Argonne/Envia composite electrode material technology for hybrid and all-electric vehicles

-more-

High Performance Software for Engineering and Science

PETSc is designed to allow engineers and scientists to perform large-scale numerical simulations of physical phenomena rapidly and efficiently. Representative simulations to date include fluid flow for aircraft, ship, and automobile design; blood flow simulation for medical device design; porous media flow for oil reservoir simulation for energy development and groundwater contamination modeling; modeling of materials properties; economic modeling; structural mechanics for construction design; combustion modeling; and nuclear fission and fusion for energy development. These simulations allow the effects of design decisions to be evaluated and compared, including cost benefits, safety concerns, and environmental impact.

The ability to perform simulations allows corporations and governmental agencies to replace costly and dangerous experiments and prototypes. Simulations have led to many new products as well as improvements in existing products.

Funding was provided by the Department of Energy, Office of Science.

The principal developers are Satish Balay, Argonne senior software developer; Kris Buschelmann, former Argonne software developer; Lisandro Daniel Dalcín, post doctoral researcher with Consejo Nacional de Investigaciones Científicas y Técnicas; Victor Eijkhout, University of Texas at Austin research scientist; William Gropp, University of Illinois at Urbana-Champaign professor; Dmitry Karpeev, Argonne assistant computational mathematician; Dinesh Kaushik, Argonne computational scientist; Matthew Knepley, Argonne assistant scientist; Lois Curfman McInnes, Argonne computational scientist; Barry Smith, Argonne senior computational mathematician; and Hong Zhang, Illinois Institute of Technology research associate professor.

R&D100—add two

Super hard and slick coating (SSC) for increased engine efficiency and component reliability

Superhard and slick coatings can improve the performance of all kinds of moving mechanical systems, including engines. Friction, wear, and lubrication strongly affect the energy efficiency, durability, and environmental compatibility of such systems. As an example, frictional losses in an engine may account for 10-20 percent of the total fuel energy (depending on the engine size, type, driving conditions, and weather, for example). The amount of emissions produced by these engines is also strongly related to their fuel economy. In general, the higher the fuel economy, the lower the emissions. In fact, achieving higher fuel economy and lower emissions is one of the most important goals for all industrialized nations. SSC with its self-lubricating and low-friction nature can certainly help to increase the fuel economy of future engines.

The SSC is a designer coating: The ingredients used to make it were predicted by a crystal-chemical model proposed by its developers. In laboratory and engine tests, SSC reduced friction by 80 percent compared to uncoated steel and virtually eliminated wear under severe boundary-lubricated sliding regimes.

Tribological materials in future engine systems will be subjected to much higher thermal and mechanical loads and will be supplied with less effective but more environmentally sound lubricants in much reduced quantities. As exemplified above, energy saving and environmental benefits resulting from the uses of SSC are real. Currently, the USA consumes nearly 13 million barrels of oil per day to power motored vehicles. The total energy losses resulting from friction in these vehicles are estimated to account for about 15 percent of the fuel's energy. Therefore, even it can be reduced by one third by advanced friction control technologies like SSC, billions of dollars could be saved every year.

Funding was provided by the Department of Energy's Office of Energy Efficiency and Renewable Energy.

.

The SSC was jointly developed by a team from Argonne and Istanbul Technical University. Galleon International Co., Brighton, Mich, and Hauzer Technocoating, The Netherlands licensed the patents. The Argonne team included Ali Erdemir, senior scientist and Osman Levent Eryilmaz, materials scientist. The Galleon team included Mark Dorbeck, president and Frank Sykora, director. The Hauzer team included Thomas Krug, chief executive officer; Roel Tietema, process engineering manager; and Ruud Jacobs, engineer. Other developers included Mustafa Urgen, Istanbul Technical University professor; Kursat Kazmanli, Istanbul Technical University associate professor; Ozgul Keles, Istanbul Technical University assistant professor; and A. Fuat Cakir, Istanbul Technical University professor.

Hard X-ray Nanoprobe for X-ray microscopy

The Hard X-ray Nanoprobe (HXN) provides x-ray imaging and x-ray analysis at a spatial resolution previously not available in the hard x-ray range. The system also provides qualitative new characterization capabilities by combining full field transmission imaging with scanning probe capabilities.

Significant advances in high-accuracy positioning allow positioning of the X-ray optics and sample with an accuracy of two nanometers. This enables the use of advanced X-ray optics—stacked zone plates, multilayer Laue lenses—with a spatial resolution of 30 nanometers or below, providing an unmatched spatial resolution in the hard X-ray range. This has already provided users a better understanding of strain in silicon based devices, distribution of matrix elements in geopolymers, Resistive RAM systems and novel nanocomplosites

The HXN will also significantly improve the ability of medical scientists and nanoscientists to study use of nanocomposites in tissues, cells and subscellular organelles, which helps develop new medical imaging techniques and therapies.

The HXN is the first system to integrate X-ray fluorescence, X-ray diffraction, and fullfield imaging exchangeable into a single instrument. This allows fast acquisition of full-field tomographic images combined with X-ray fluorescence and/or X-ray diffraction characterization in situ. The HXN offers the combination of superior hard x-ray spatial resolution with very high elemental and strain sensitivity and operation at atmospheric pressure or in a vacuum. It takes advantage of the properties of hard x-rays by allowing imaging of thick and optically opaque samples, the study of inner structures and buried interfaces, while being nonintrusive and nondestructive.

The HXN was jointly developed by a team from Argonne and Xradia Inc. The Argonne team consisted of Jörg Maser, physicist; Deming Shu, senior engineer; Robert Winarski, physicist; Martin Holt, assistant physicist; Brian Stephenson, senior physicist; and Volker Rose, assistant physicist. The Xradia Inc. team consisted of Michael Feser, VP/GM X-ray Nano-Imaging; Tobias Beetz, project manager; Juana Rudati, project manager; and Wenbing Yun. President/ CTO.

Argonne/Envia composite electrode material technology for hybrid and all-electric vehicles

The Argonne/Envia Systems lithium-ion battery technology provides the highest energy and cycle life of all lithium-ion systems available today for the plug-in hybrid electric vehicle (PHEV) and electric vehicle markets and will help facilitate meeting the stringent USABC requirements for powering 40-mile-range PHEVs. The new battery technology will therefore contribute to lowering America's dependence on foreign oil and slashing harmful emissions at the same time. Because of its high energy, high cycle life, competitive power, relatively low cost, and improved safety, the technology also provides a "drop-in" alternative that will enhance the performance of today's lithium-ion batteries in a variety of smaller-scale applications such as cell phones, laptop computers, and power tools.

This product was jointly developed by a team from Argonne and Envia Systems. The Argonne team consisted of Michael Thackeray, Argonne Distinguished Fellow; Khalil Amine, senior scientist; Christopher Johnson, chemist; Sun-Ho Kang, materials scientist; Ilias Belharouak, materials scientist; and Haixa Deng, post doctoral appointee. Other researchers were Jaekook Kim, associate professor, now at Chonnam National University, Korea and Sujeet Kumar, chief executive officer of Envia Systems.

Beyond the four awards, Argonne scientists were part of a collaborative project to develop an artificial retina that won an R&D 100 Award. The project involved researchers from several other national laboratories, universities and other organizations. Argonne representatives who contributed to the work include senior physicist Orlando Auciello, staff scientist Bing Shi and post doc Wei Li jointly won an award for the artificial retina bioelectric implant. Lawrence Livermore National Laboratory was the submitting organization.

The U.S. Department of Energy's Argonne National Laboratory seeks solutions to pressing national problems in science and technology. The nation's first national laboratory, Argonne conducts leading-edge basic and applied scientific research in virtually every scientific discipline. Argonne researchers work closely with researchers from hundreds of companies, universities, and federal, state and municipal agencies to help them solve their specific problems, advance America's scientific leadership and prepare the nation for a better future. With employees from more than 60 nations, Argonne is managed by UChicago Argonne, LLC for the U.S. Department of Energy's Office of Science.